fection in material submitted for examination. In one case, plague infection was found to be undoubtedly present, and the report of the laboratory upon it was made immediately. In a second case the appearances presented were suspicious, and the report of the laboratory enabled precautions to be taken to safeguard the city in the event of true plague appearing. More accommodation for this kind of research work is required, as there is no lack of persons willing to undertake it. The same remark applies to other departments of the College. If people of means in Bristol and the neighbourhood took any interest in educational progress, the establishment of the University of Birmingham, and the movement in favour of other universities of a similar kind, would inspire them to action in the same direction. There is room for a University of the West of England, and if Bristol does not rise to its opportunity another city of the west will take its place. The subject has been brought up over and over again, and only a few days ago Mr. Haldane spoke in favour of it at the annual dinner of the University College Colston Society. The Bishop of Hereford also alludes to it at the end of the present report. But the rich citizens of Bristol do not seem to understand what has been done by private persons for higher education in cities like Liverpool, Birmingham and Manchester, or if they know they apparently have no desire to follow the example. There will have to be a complete awakening of the spirit of pride in local resources for education and research before Bristol can make any real movement towards a University of the West of England.

SCIENTIFIC SERIALS.

Transactions of the American Mathematical Society, vol. iii. No. 1, January.—On a class of automorphic functions, by J. L. Hutchinson. In Burkhardt's "Ueber die darstellung einiger fälle der automorphen primformen durch Specielle Thetareihen," the following monodromy group of the Riemann surface, $y^3 = (x-\alpha_1)(x-\alpha_2)(x-\beta_1)^2(x-\beta_2)^2$, is considered, and he shows how a certain prime form which is automorphic for the group can be expressed by a theta series. Further results are here given concerning the group and the functions belonging to it, the chief object being to obtain explicit analytic formulæ by means of which all functions of the group can be represented. To this end the theta-fuchsian functions of Poincaré are introduced, and their expressions in terms of the hyperelliptic theta series deduced.—Concerning the existence of surfaces capable of conformal representation upon the plane in such a manner that geodetic lines are represented by a prescribed system of curves, by H. F. Stecker, is in continuation of a previous paper under nearly the same title (vol. ii. p. 152).—Zur erklärung der Bogenlänge und der inhaltes einer Krummen fläche, by O. Stoll (*cf.* the author's "Grundzüge der Differential- und Integralrechnung," Bd. 2, and *Math. Ann.*, Bd. 18).—The groups of Steiner in problems of contact, by Dr. L. E. Dickson, gives an elementary proof of Jordan's ("Traité," pp. 229–249). Reference is given to Steiner and Hesse (*Journal für Math.*, vol. xlix. (1855) and vol. lxiii. (1864), and to papers by the author (*Bulletin* Amer. Math. Soc., vol. iv., and the *American Journal of Mathematics*, vol. xxiii. pp. 337–377).—Quaternion space, by A. S. Hathaway, follows up Stringham's work in vol. ii. p. 183, but frequent reference is made to Clifford's paper on biquaternions. Stringham deals analytically with the equations of loci and develops the geometry by the interpretation of those equations; the author uses a more synthetic method, which interprets the quaternion symbols themselves instead of the equations between them. It is this divergence which constitutes the general difference between the methods of Cayley and Tait. Clifford stated the synthetic view in his Further note on biquaternions.—Reciprocal systems of linear differential equations, by E. J. Wilczynski, arrives at interesting results in connection with previous papers (*Transactions*, vol. ii. No. 4; *American Journal of Mathematics*, vol. xxiii.).—On the invariants of quadratic differential forms, by C. N. Haskins, investigates, by means of Lie's theory of continuous groups, the problem of determining the number of invariants of the general quadratic form in n variables. Numerous references occur in the paper.—On the nature and use of the functions employed in the recognition of quadratic residues, by Dr. E. McClintock, refers to Tannery, "Leçons d'Arithmétique," Bachmann, "Elemente der Zahlentheorie," and to Baumgart, "Ueber der Quadratische Reciprocitätsgezetz."—A determination of the number of real and imaginary roots of the hypergeometric series, by E. B. Van Vleck. Concisely we must refer to Klein (*Math. Ann.*, vol. xxxvii. p. 573) for the number of the roots of the equation considered between 0 and $-\infty$. Mr. Van Vleck claims that he gives, for the first time, the number of imaginary roots. Numerous references and diagrams (six and a page of sixteen) accompany the text.—The second variation of a definite integral when one end-point is variable, by G. A. Bliss. The method which the author applies to the discussion of the case in which one end-point moves on a fixed curve is closely analogous to that of Weierstrass ("Lectures on the Calculus of Variations," 1879). In the present case terms outside of the integral sign are taken into consideration. Then, as a result of the discussion, the analogue of Jacobi's criterion is derived, defining, apparently in a new way, the critical point (Kneser's "Brennpunkt") for the fixed curve along which the end-point varies. Then the relation between the critical and conjugate points is discussed.—On the projective axioms of geometry, by E. H. Moore, contains a consideration of the axioms called by Hilbert ("Grundlagen der Geometrie") the axioms of connection and of order, and by Schur ("Über die Grundlagen der Geometrie") the projective axioms of geometry. There are several citations of authorities, such as Peano, Pasch and Ingrami.

Bulletin of the American Mathematical Society, January.—Note on Mr. George Peirce's approximate construction for π, by E. Lemoine. This article gives four constructions suggested by a discussion of Mr. Peirce's which we have previously noticed (*Bulletin*, July, 1901). The relative theoretic exactness is determined by calculating the true value of the length which in each case approximately represents π. The solutions are worked out by aid of the geometrographic notation. A slight sketch of this method, sufficient for the present purpose, is given. (For a fuller account, reference may be made to M. Lemoine's "La Géométrografie" or to the "Traité de Géométrie" in the *Archiv. der Mathematik und Physik*, April and May, 1901, vol. i., Gauthier-Villars). There is also appended a close approximation to the trisection of an angle by C. Störmer worked by the same method. There are several diagrams.—Concerning the elliptic $\wp\,(g_{2}, g_{3}, z)$ functions as coordinates in a line complex, and certain related theorems, by Dr. H. F. Stecker, is an application of the coordinates to the Kummer surface and certain other configurations (*cf.* Klein, *Math. Ann.* vol. v., pp. 294–5).—A short note on the Abelian groups which are conformal with non-Abelian groups follows, by Dr. G. A. Miller. Dr. S. E. Slocum writes on the infinitesimal generators of certain parameter groups. The paper opens with a *résumé* of the method employed by the author on pp. 97–103 of the *Proceedings* of the American Academy of Arts and Sciences, vol. xxxvi., and then proceeds to give tables in which are enumerated all possible types of structure of two-, three- and four-parameter complex groups as given by Lie, and under each structure are given the symbols of the infinitesimal transformations which generate the parameter group corresponding to that structure, obtained by the method referred to above (*cf.* Lie, "Continuierliche Gruppen," pp. 565–589; "Transformations Gruppen," vol. iii., pp. 713–730).—Notices follow of the "Einführung in die Theorie der Differential gleichungen mit einer unabhängigen Variabeln" of Dr. L. Schlesinger and of Prof. Hatzidakis's "ἐισαγωγὴ εἰς τὴν Ἀνωτέραν Ἀλγέβραν."—The usual information of interest to mathematicians follows in the form of notes and new publications.

Annals of Mathematics, January.—Some applications of the method of abridged notation, by Maxime Bôcher, is an interesting elementary paper the nature of which may be gathered from an illustration. Let the sides of a triangle be $u=0, v=0, w=0$ (where $u \equiv x\cos\alpha + y\sin\alpha - p$), then $u-v=0$, $v-w=0$, $w-u=0$ are the bisectors of the angles, and as the sum of the sinisters vanishes identically we get the property of the bisectors of the angles cointersecting in a point. If, again, $u \equiv x^2+y^2+ax+by+c=0$ and so on, we can show that the common chords of three circles meet in a point. The author then proceeds to the proof of Desargues' theorem and thence to generalisations for four circles and for curves of the nth order, and extends, by suggestion, his results to surfaces.—On the roots of functions connected by a linear recurrent relation of the second order, by M. B. Porter, reproduces in part some unpublished theorems of Sturm (*cf.* "Liouville," vol. i.), and shows how, by means of the Cauchy-Lipschitz theorem for the existence of solutions of a differential equation, it is possible to establish

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rigorously the analogous theorems, so far as they exist, for the homogeneous linear differential equations of the second order. The article closes with some applications.—Space of constant curvature, by F. S. Woods, is an attempt to present Riemann's ideas (*cf.* the "Ueber die Hypothesen, welche der Geometrie zu Grunde liegen") in an elementary form. The paper is given in part and is useful, in addition to the results worked out, for its bibliographical references.

SOCIETIES AND ACADEMIES.

LONDON.

Royal Society, January 23.—"The Affinity of Tmesipteris with the Sphenophyllales." By A. P. W. Thomas, M.A., F.L.S., University College, Auckland, New Zealand.

In the present paper the author deals with the nature of the synangium of Tmesipteris, as based on the study of variations observed in the sporophyll, beyond the limits already recorded by Bower.

The term "sporophyll" is used to denote the whole fertile structure, the term "synangium" restricted to the sporangiophore. Three types of variation are recorded, viz. (1) that of repeated dichotomy of the sporophyll with two to three synangia; (2) that in which the synangium is raised upon a pedicel or stalk; (3) that in which the synangium is replaced by a leaf-lobe of normal appearance. It is shown that abnormality in the sporophylls and synangia, which commonly occurs at the beginnings or ends of the fertile zones, is not found in cases where the sporophyll shows excessive leaf development. In these it occurs rather towards the middle region, and it is inferred that if the nutritive conditions remained equally satisfactory throughout, the whole sporophyll series should show repeated dichotomy.

Concerning the second type of variation, the synangium is found to have become so revolved upon a transverse axis that its longitudinal groove faces outwards between the leaf-lobes, assuming a position the more favourable to dispersal of the spores. In the third type the leaf is shown to be forked, although the synangium, if present at all, exists only in an abortive form. From the fuller study of this, the author suggests that the synangium is the morphological equivalent of a ventral leaf-lobe.

Passing to questions of classification, the author refers to the difficulties in reconciling the sporangium-bearing structures of the Psilotæ with those of the typical Lycopodinæ. He enters into a comparison with the extinct Sphenophyllales, with especial reference to Bowmanites and Cheirostrobus, and concludes that the relationships of Tmesipteris and Psilotum with this group are perhaps even closer than is supposed by Scott.

In an addendum, received since this paper was announced, the author makes good his desire to deal extensively with the Psilotum sporophyll, the leaves of which, though greatly reduced and xerophytic, are shown to be essentially similar to those of Tmesipteris.

Society for Psychical Research, January 31.—Dr. Oliver Lodge, F.R.S., delivered his presidential address. Dealing first with the phenomena of trance, lucidity and clairvoyance, he expressed the opinion that much more information was required before we could even formulate the problems raised by these faculties. With regard to physical phenomena, he thought much of the extra difficulty of accepting evidence for unusual phenomena was due to the *a priori* notion that such occurrences are contrary to natural law. We cannot, however, clearly tell that they are contrary to natural law; they are only contrary to and supplementary to our usual experience. The objection of science to psychical research is mainly due to the fact that it regards psychical phenomena as unintelligible. It is accustomed to simplify its problems by the method of abstraction and has got into the habit of thinking that it actually excludes disturbing causes; the abstraction cannot really exclude from the universe anything apparently disorderly. Theoretically, this is universally admitted; practically science has excluded psychical phenomena from its experimental area. He was not prepared to say that physical phenomena such as materialisations, the passage of matter through matter, and levitation were impossible and absurd, so that no testimony ought to produce any effect on our incredulity. Extreme caution was necessary and full control must be allowed to the observers. His personal belief was that man survived death, and this belief had been produced b scientific evidence. He did not attribute the physical phenomena of spiritualism to the agency of the departed, but was disposed to regard trance utterances as in some cases due to telepathic communication with some unconscious stratum of a departed person.

Royal Microscopical Society, January 15.—Mr. Wm. Carruthers, F.R.S., president, in the chair.—This being the annual meeting of the Society, the president gave an address on the scientific work of Nehemiah Grew, from 1641–1712, whom he defended from the charges of plagiarism which had been brought against him in respect to his discoveries as to plant structure.—Mr. E. A. Parsons gave an exhibition of malaria parasites under a number of microscopes, lent for the occasion by Messrs. Chas. Baker.—Messrs. Ross exhibited their new form of standard microscope, designed specially for the use of medical students, fitted with a new form of fine adjustment. Messrs. Ross also exhibited a simple lens for dark ground illumination. It consists of a meniscus lens bored through its centre to receive a spot made of vulcanite provided with a stem to drop into the hole in the centre of the lens.

Geological Society, January 22.—Mr. J. J. H. Teall, V.P.R.S., president, in the chair.—The fossiliferous Silurian beds and associated igneous rocks of the Clogher Head district (county Kerry), by Prof. S. H. Reynolds and Mr. C. I. Gardiner. The authors give a detailed description of the coast from Dunquin past Clogher Head to Coosglass (south of Sybil Point), and of the western side of Smerwick Harbour. They next deal with the inland exposures, which are not very frequent, but include considerable rock-masses at Croaghmarhin and Minaunmore Rock. The rocks consist of sandstones, slates, calcareous flags, ashes and ashy conglomerates, rhyolitic lava-flows and various intrusive rocks. The general structure is an S-shaped fold, inverted towards the north so that the dip of the beds is approximately south-easterly, and the oldest beds occur to the north, at Coosglass. Both anticline and syncline are faulted, and a patch of Old Red Sandstone is caught in under the synclinal thrust at Coosmore. Fossils, mainly corals, brachiopods, lamellibranchs and gasteropods are fairly abundant; but trilobites are rare and graptolites absent. The whole of the fossiliferous rocks are of Silurian age; the majority of those exposed on the coast are of Wenlock or Wenlock-Llandovery age, while the majority of those exposed inland are of Ludlow age.—A process for the mineral analysis of rocks, by Prof. W. J. Sollas, F.R.S. The method proposed is to obtain a quantitative estimation of the mineral composition of a rock, and from the known composition of the minerals to calculate the percentage-composition of the rock. The specific gravities of the minerals are first determined by means of a diffusion-column of methylene-iodide and beads of known specific gravity, and the presence or absence of particular minerals settled for a certainty. Next, the separation of the minerals in a weighed quantity of the powdered rock is undertaken by means of a special separator, the method being illustrated by the example of a rock containing orthoclase (sp. gr. 2·56), quartz (2·65), andesine (2·67), biotite (3·1), pyroxene (3·3) and magnetite. The first separation would be with a liquid of sp. gr. 2·885, the mean of that of andesine and biotite; the next with a liquid of sp. gr. 2·66; the next 2·605, and so on for the other constituents. The separated minerals are dried and weighed, the loss distributed, and the analysis checked by comparing the specific gravity of the rock in bulk with that calculated from the specific gravity and proportion by weight of its constituents.

DUBLIN.

Royal Irish Academy, January 13.—Prof. R. Atkinson, president, in the chair.—Prof. T. Johnson communicated, on behalf of the fauna and flora committee of the Royal Irish Academy, a paper by Mr. W. West and Prof. G. S. West entitled "A Contribution to the Freshwater Algæ of the North of Ireland." This paper gives the results of the examination of material collected by the authors in 1900 and 1901 in Lough Neagh and district, and in co. Donegal. 139 genera, 604 species and 106 varieties are recorded. Of these some twelve, described and illustrated, have been hitherto unknown, twenty-four others are new to the British Isles, many others new to Ireland, and the distribution of yet others, recorded by the late Mr. W. Archer, F.R.S., and Rev. E. O'Meara, is largely

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